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ABSTRACT

This paper is one of several reports being prepared by the Energy Task Force on the impact of energy supply and cost trends on nonprofit educational institutions. This particular report focuses on the need to render educational facilities more energy-efficient through a program of capital investments focused on the rehabilitation of existing buildings. The report identifies the advantages offered by federal support of a building rehabilitation program that reduces both energy consumption and costs in the educational sector; it also outlines a phased investment plan for educational institutions involving progressive levels of technical sophistication and expenditure. Several tables that summarize survey data on the energy consumption and energy costs of 46 American colleges and universities are also included. Although the quantitative data applies specifically to institutions of higher education, most of the report applies equally to elementary and secondary schools as well. (Author/JG)

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ENERGY CONSERVATION

The Capital Investment Needs for Building Rehabilitation for Non-Profit Educational Institutions

An analysis by the Energy Task Force

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Paper #2
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I. INTRODUCTION

This paper is one of several reports to be issued by a non-profit education Energy Task Force. This Task Force, created by the National Association of College and University Business Officers (NACUBO) and the Association of Physical Plant Administrators (APPA) and sanctioned by the American Council on Education (ACE), is responsible for assessing the impact of energy supply and cost trends upon non-profit educational institutions. The Task Force is exploring with federal agencies and congressional leadership ways by which the educational sector can be sensibly integrated into emerging national energy policy.

The purpose of this report is to focus attention on one of the most critical energy problems presently faci.. educational institutions: the need to render educational facilities more energy efficient through a program of capital investments focused upon the rehabilitation of existing buildings. The report identifies the advantages offered by federal support of a building rehabilitation program which reduces both energy consumption and costs in the educational sector. The report also outlines a phased investment plan for educational institutions involving progressive levels of technical sophistication and expenditure.

Although the Task Force has only been operational since early 1975, it is already clear that the highest priority must be assigned to the need for building rehabilitation funds to assist educational institutions in their attempts to reduce energy consumption and costs. Such priority is not only essential for the economic relief of educational institutions, but is also important in the national effort to achieve a goal of energy independence through energy conservation.

While the quantitative data included in this analysis specifically addresses the needs of higher education, it is self-evident that primary and secondary schools are faced with problems of the same magnitude. The Task Force is in the process of gathering information in order to more accurately assess the energy consumption requirements of the public and private pre-college institutions. It is clear, however, to the Task Force that capital expenditures in elementary and secondary schools will be required to reduce energy consumption and therefore the costs of education. It is also obvious to the Task Force that in national energy conservation terms alone, the consumption reduction potential in elementary and secondary schools is enormous, though the data presently on hand renders a precise estimate impossible at this time.

II. SUMMARY AND CONCLUSIONS

The absence of a national energy policy during the past three decades not only lulled the nation into a false sense of security with regard to energy matters, but also resulted in capital expansion that will, if not corrected, work to the detriment of the national goals of energy independence and economic stability. The past decades witnessed a rapid growth and expansion of educational institutions to keep pace with the rising demands of a growing student population and the high national priority given to research and scientific activity. During this era of relatively inexpensive energy, buildings were erected with minimal concerns for efficient energy consumption.

Events of the 1970s have rudely shaken this delicate imbalance. The leveling of student enrollment challenges the established assumption that growth is good. Environmental regulations, predicted energy shortages, skyrocketing energy costs and emerging national energy policy require a reassessment and redirection of educational facility resources.

The time has arrived to reallocate funds away from the construction of new facilities. Future funding must focus on the rehabilitation of existing facilities to render them energy efficient and cost effective.

The consolidation of resources must receive primary attention be they energy resources, educational operating budgets, tuition payments or facility operating expenses. The allocation of building rehabilitation funds to educational institutions offers a unique opportunity to make substantial progress toward the national goals of energy independence and economic stabilization. The proven opportunities for energy consumption reduction through renovations of facilities, the existing technical expertise in conservation practices, and the established pattern of information and experience sharing places the educational sector in an enviable position to maximize the return on dollars allocated for energy conservation.

Rehabilitation plans and programs ready for execution but awaiting funding can immediately create new construction jobs in an industry hard hit by unemployment. Moreover this construction activity will not result in new energy demands but will reduce energy consumption and thus the pressures upon school operating budgets and tuitions.

The federal government can be the catalytic agent in the achievement of these energy conservation and economic stabilization benefits through the release of funds to support building rehabilitation investments. Capital funds are badly needed to afford institutions the opportunity to capitalize upon energy conservation opportunities; opportunities which are currently available and nationally important but financially unattainable without capital support.

1. Non-profit institutions of higher education spend more than $1.2 billion annually on energy, or an equivalent of 100 million barrels of fuel oil per year. In the national pursuit of the goal of energy independence, the consumption reduction potential of such a significant category of user cannot be overlooked.

2. Meteoric increases in the cost of energy, building systems designed and constructed to consume inexpensive energy, complex environmental regulations and the absence of a national energy policy have weakened the already precariously balanced financial positions of many institutions.

3. Non-profit educational institutions continue to be excluded from all of the proposed economic relief plans set forth by the Administration and Congress such as credits for energy investments and capital support for conversion to more efficient energy sources. Such an oversight aggravates the dilemma of increased energy costs.

4. The inflationary impact of the rising costs of higher education has staggered many state and local governments, taxpayers, and tuition-paying parents, thus threatening to price higher education beyond the reach of many students. A reduction in operating costs for energy within educational budgets will have a positive deflationary effect on many Americans while providing the additional advantage of further stimulating energy conservation activities toward the goal of national energy self-sufficiency.

5. Energy consumed within educational institutions is essentially non-discretionary, supporting such high priority functions as food processing, space heating and medical service at the teaching, research and clinical levels.

6. Field experience within non-profit institutions of higher education indicates that a properly phased program of investments of approximately $2.00 per gross sq. ft. can reduce energy consumption by at least 25%, with a potential reduction as high as 40% in some of the more sophisticated research institutions.

7. Due to the clear pattern of mutual cooperation and information sharing which has existed among educational institutions, funds spent for energy conservation would be uniquely amplified in a manner unavailable in the more competitive sectors of the energy consuming economy.

8. The total size of existing facilities at institutions of higher education amounts to approximately 1.9 billion sq. ft. To realize consumption reductions in the range of 25-40% funds of $3.8 billion will

be required based on a rehabilitation investment of $2.00 per gross sq.ft. Existing federal appropriation mechanisms provide several opportunities for this type of funding especially in the area of matching facilities grants.

9. Approximately 265,000 construction jobs would be created by the suggested $3.8 billion building rehabilitation program, based upon AFL/CIO estimated 70,000 construction jobs per $1 billion of construction expenditures; this economic stimulus to be achieved by an investment program which will reduce both energy consumption and the cost of education nationally.

III. Program for Building Rehabilitation Investments

A. Financial Criteria and Capital Needs

It is axiomatic that energy conservation investments must meet the return on investment criteria fundamental to any capital expenditure decision. Building rehabilitation expenditures are no exception to this principle. Fortunately, the rates of return on rehabilitation expenditures are extremely attractive as measured in terms of their cost savings and cost avoidance potential. Investment payouts within three to five years are the rule rather than the exception for intelligently planned conservation rehabilitation programs.

Regrettably, there has been a serious shortage of capital funds available to educational institutions for rehabilitation investments.

Elimination of this shortage of capital funds requires that a stronger case be made for the value of such investments than has been made in the past. The preliminary surveys of the Energy Task Force have revealed impressive conservation performances across many institutions; performances which deserve recognition and can provide impetus for further conservation activity. Perhaps even more importantly, these positive energy conservation performances substantiate the growing need for capital in order to accelerate the trend toward energy conservation investments.

B. Phasing of Rehabilitation Investments

Review of higher education's institutional conservation case histories discloses a three-phase pattern of building investment programs which affords energy consumption reduction opportunities at varying levels of expenditure. The three phases may be classified as:

Phase	Consumption Reduction	Level of Expenditure Per Sq. Ft.
QUICK FIX	10%	$ .00
REFIT	20 - 25% (including QUICK FIX)	.25-1.20
SYSTEMS CONVERT	30 - 40% (including REFIT)	1.20-2.00

A vital component of this phased energy consumption reduction would be the development of a method for reviewing the consumption reduction progress of a specific institution so that federal funding agencies could be assured of an optimum return on a capital rehabilitation investment. Such mechanisms as inter-institutional review groups, state and federal energy audits and site visits by a board whose membership would include university administrators, federal energy experts and representatives of the funding source would insure the effective allocation and proper phasing of rehabilitation funds. An institution would be required to prove the successful establishment of a QUICK FIX program prior to receiving REFIT funds and would also have to demonstrate intelligent and productive use of REFIT monies before receiving SYSTEMS CONVERT aid.

C. PHASE 1 - QUICK FIX

Definition and Cost:

This initial phase involves basic and important energy savings which are easily attainable at negligible cost. Non-technical energy conservation measures such as lowered temperatures and regular preventive maintenance will quickly eliminate obvious energy waste and result in energy consumption reductions of at least 10% for most institutions. Minimal lead time is required for the implementation of a QUICK FIX program, especially if campus-wide cooperation can be elicited for achieving such vital consumption reductions.

It is clear from EXHIBIT I that institutions of higher education are making significant progress in their efforts to conserve energy. Most of the schools represented in EXHIBIT I have already implemented successful QUICK FIX programs and are moving into more sophisticated conservation activities as evidenced by an average energy consumption reduction of 17.53% for the four-year schools and 12.17% for the two-year schools. Further consumption reductions, which are attainable and must be realized, will require capital support.

EXAMPLES: QUICK FIX

1. Specific temperature ranges and thermostat settings:

   65-68° Winter
   75-80° Summer

2. Reduction in illumination levels and lamp wattage.
3. Night and weekend building shutdowns.
4. Consolidation of activities into fewer buildings, particularly during evenings and weekends.
5. Scheduling of vacations during energy intensive periods.
6. Restrictive policy on appliance usage and air conditioning installation.
7. Reduction of hot water temperature.
8. Work schedule adjustments to maximize daylight working hours.
9. Reduction of building heat leakage using blinds and drapes.
10. Maintenance review of existing energy systems:
    a) Inspections of steam traps.
    b) Inspection of valve functions and air filtration systems.
    c) Installation of stack emission monitors.
11. Total involvement of the entire institutional community:
    a) Faculty, staff, student energy committee.
    b) Appointment of building energy monitors.
    c) Energy briefing sessions with building occupants.

D. PHASE 2 - REFIT

Definition and Costs:

This second phase goes beyond the simple steps taken in the QUICK FIX stage. The expected consumption reduction of 20-25% requires a capital investment of approximately $.25-1.20 per gross sq.ft. Greater attention in this phase must be devoted to the development of technical studies in an effort to diagnose the differing types and levels of energy consumption within an institution prior to committing capital to a specific investment option.

EXHIBIT I illustrates that a number of institutions have entered the REFIT phase using modest amounts of self-generated capital funds. Regrettably, a shortage of available capital has hampered many institutions from executing further conservation plans; plans which are ready for immediate implementation requiring only capital support.

EXAMPLES: REFIT

1. Energy Technical Studies:
   a) Classification of buildings by function, energy consumption and sq.ft. costs.
   b) Review of existing mechanical systems and controls to identify capital investment options.
   c) Infra-red aerial photographic survey to identify heat loss.
   d) Review of electrical rate structures, power factors, load profiles and demand peaks.
   e) Development of energy efficient space allocation practices.
2. Modification of Lighting Systems:
   a) Conversion from incandescent to fluorescent fixtures.
   b) Utilization of time clocks on lighting systems.
   c) Revision of light switch circuitry to reduce overlighting.
3. Reduction of Heating and Air Conditioning System Losses:
   a) Increase steam line insulation.
   b) Roof and wall insulation.
   c) Weatherstripping, storm windows, caulking, sun screens, blinds.
4. Refinement of HVAC Control Systems:
   a) Rezoning of heating systems.
   b) Installation of timers on exhaust and air handling systems.
   c) Installation of variable speed drives on motors.
   d) Installation of motorized steam valves.
   e) Reduction of fresh air makeup.

E. PHASE 3 - SYSTEMS CONVERT

Definition and Costs:

The third and most sophisticated level of conservation investment, SYSTEMS CONVERT, requires capital expenditure for engineering and other technical studies and substantial conversion of building systems in order to achieve this dramatic consumption reduction. An additional 10-15% reduction can be achieved after the first and second phases, at an incremental cost of approximately $.80 per gross sq.ft.

The cumulative impact of the three phases results in an institutional consumption reduction ranging from 30% to 40% at a total cost which

would not exceed $2.00 per gross sq.ft. It is important to recognize that not all institutions or all buildings within a given institution can benefit from this highly technical SYSTEMS CONVERT phase. However, significant savings of energy as a result of SYSTEMS CONVERT investments would accrue to institutions engaged in basic scientific research and in the delivery of health care at the research and clinical levels. Such institutions consume a major portion of the total energy used within the educational sector. As such, these institutions represent desirable focal points for investment from a national energy conservation standpoint irrespective of the additional incentive of lowered operating costs within the institution.

EXAMPLES: SYSTEMS CONVERT

1. Installation of central computerized controls and building monitoring systems.
2. Installation of waste heat recovery systems.
3. Conversion of Building Systems:
   a) Solar energy systems.
   b) Independently zoned environment controls for laboratories and other specialized space.
   c) Rewiring of major electrical systems to minimize demand changes and avoid establishing new peaks.
4. Upgrading of Primary Boiler and Chiller Plants:
   a) Conversion to alternate fuel sources.
   b) Automation of power plants.
   c) Utilization of solid waste recovery fuel systems.

IV. Funding of Building Rehabilitation

Achievement of an energy consumption reduction in the range of 25-40% in educational facilities will require an investment of $2.00 per gross sq.ft. This amount, allocated to the 1.9 billion sq.ft. of existing higher education facilities creates a capital need of $3.8 billion for energy related building rehabilitation.

Neither all institutions nor all buildings within an institution require $2.00 per sq.ft. to achieve optimum consumption reductions. The variance of investment needs across institutions suggests the need for the careful phasing of funds over a period of years to insure the allocation of available rehabilitation funds to the most desirable conservation opportunities. The development and continuing refinement of energy conservation technology is a predictable phenomenon. The cumulative experience of educational institutions in the field of energy conservation will continue to provide energy opportunities unknown today but highly feasible and desirable for the future. Educational institutions, once having initiated aggressive energy

conservation programs, will thus be motivated to achieve progressively greater consumption and energy cost reductions under the continuing stimulus of visible funding sources to finance building rehabilitation investments.

In sum, the rationale of phasing rehabilitation funding over an extended period, such as five years, is essential to insure investment in the most attractive energy conservation options, and to do so at a pace that will neither outstrip emerging technology nor an institution's technical capacity to wisely invest funds available to that institution. The funding of such investments must start somewhere. To date, federal energy related funding assistance which has been provided to most all sectors of the economy has not been provided to non-profit educational institutions. The need for this capital is great; the return in energy conservation is assured. Institutions are willing and technically able. What is now required is an understanding of these needs by federal administrators and Congress, and a commitment to allocate resources to assist non-profit educational institutions.

April 17, 1975

AMERICAN COUNCIL ON EDUCATION
NACUBO - APPA ENERGY TASK FORCE
ENERGY CONSUMPTION SURVEY

March 27, 1975

College or University	Primary Fuel Type	Secondary Fuel Type	Other Purchased Energy Types	FISCAL YEAR 69-70 Total Energy Cost In Dollars	FISCAL YEAR 69-70 Energy Cost As A Percentage Of Total Institutional Expenditures	FISCAL YEAR 74-75 PROJ. Total Energy Cost In Dollars	FISCAL YEAR 74-75 PROJ. Energy Cost As A Percentage Of Total Institutional Expenditures	Energy Cost Ratio 74-75 over 69-70	Percentage Reduction In Energy Consumption Due To Conservation Program	Enrollment H.E.G.I.S. - F.T.E.	Institutional Gross Square Footage Serviced	Length of School Year In Months	Type of Institution*
CHICAGO	GAS	OIL	ELEC	$ 1,810,991	1.20%	$ 3,733,994	2.00%	206%	8.96%	9,064	7,645,788	11	CD1
DARTMOUTH	OIL		ELEC	$ 425,000		$ 1,500,000		352%				9	CD1
EMORY	GAS	OIL	ELEC	$ 640,000		$ 1,783,425		279%	21.00%	6,215	3,950,000	12	CD1
HOWARD	OIL		ELEC	$ 528,128		$ 2,400,000		412%		10,000		12	CD1
ILLINOIS-URBANA	OIL	OIL	ELEC	$ 2,349,209	1.30%	$ 6,659,060	3.12%	283%	25.23%	35,400	13,188,666	12	CD2
INDIANA	COAL	GAS	ELEC	$ 2,011,324	3.61%	$ 3,491,121	4.28%	174%	8.33%	27,402	11,922,590	12	CD2
INDIANA-PURDUE INDIANAPOLIS	GAS	OIL	E+STM	$ 859,270	1.52%	$ 2,082,040	3.38%	242%		12,336	3,337,022	12	CD2
IOWA	OIL	COAL	ELEC	$ 1,372,400	.90%	$ 5,465,400	2.30%	398%	12.00%	21,961	7,660,000	12	CD2
JOHNS HOPKINS	GAS	OIL	ELEC	$ 421,499	2.20%	$ 1,271,604	5.60%	302%	20.00%	4,767	1,485,000	12	CD1
KENT STATE	GAS	COAL	ELEC	$ 1,118,413	2.10%	$ 1,836,364	3.10%	164%	11.00%	17,336	4,752,657	12	CD2
MARQUETTE	GAS		E+STM	$ 511,579	2.20%	$ 732,774	2.20%	143%		8,560	2,106,000	12	C 1
MICHIGAN	GAS	OIL	ELEC	$ 2,900,000	.90%	$ 6,900,000	1.80%	238%	18.00%	33,583	17,100,000	12	CD2
MICHIGAN STATE	GAS	COAL	ELEC	$ 2,432,358	1.44%	$ 6,332,000	2.81%	260%	17.10%	43,459	15,643,444	12	CD2
MIDDLEBURY	OIL	COAL	ELEC	$ 172,314	1.90%	$ 468,589	3.50%	272%	25.00%	1,870	977,111	12	A 1
MINNESOTA	GAS	COAL	ELEC	$ 1,992,592	.85%	$ 5,678,384	1.68%	285%	17.80%	42,970	13,408,837	12	CD2
MT HOLYOKE	OIL		ELEC	$ 184,000	2.07%	$ 526,000	4.12%	286%	20.00%	1,923	1,597,000	9	A 1
NORTHWESTERN	GAS		ELEC	$ 710,679	.91%	$ 1,940,555	1.73%	273%	9.60%	9,567	4,730,232	12	CD1
NOTRE DAME	COAL	GAS	ELEC	$ 521,467	1.10%	$ 1,530,000	2.70%	293%	5.00%	8,540	4,806,945	10	CD1

* A = 4 YEAR COLLEGE C = 4 YEAR UNIVERSITY 1 = PRIVATE
B = 2 YEAR COLLEGE D = PROFESSIONAL 2 = PUBLIC

UNIVERSITIES AND 4 YEAR COLLEGES
SHEET 1 OF 2

EXHIBIT I

AMERICAN COUNCIL ON EDUCATION
NACUBO - APPA ENERGY TASK FORCE
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March 27, 1975

College or University	Primary Fuel Type	Secondary Fuel Type	Other Purchased Energy Types	FISCAL YEAR 69-70 Total Energy Cost In Dollars	FISCAL YEAR 69-70 Energy Cost As A Percentage Of Total Institutional Expenditures	FISCAL YEAR 74-75 PROJ. Total Energy Cost In Dollars	FISCAL YEAR 74-75 PROJ. Energy Cost As A Percentage Of Total Institutional Expenditures	Energy Cost Ratio 74-75 over 69-70	Percentage Reduction In Energy Consumption Due To Conservation Program	Enrollment H.E.G.I.S. - F.T.E.	Institutional Gross Square Footage Serviced	Length of School Year In Months	Type of Institution*
OHIO STATE	GAS	OIL	ELEC	$ 2,636,961	1.26%	$ 5,887,513	1.96%	223%	34.30%	50,000	15,884,701	12	C2
PURDUE	COAL	OIL	ELEC	$ 2,314,509		$ 5,163,000		223%		<1,400		12	C2
ROCKEFELLER	OIL	GAS	E+STM	$ 500,000	2.40%	$ 2,250,000	7.00%	450%	10.00%			12	C1
SOUTHERN CALIF.	GAS	OIL	ELEC	$ 558,400	.70%	$ 1,660,200	1.10%	297%	25.00%	13,365	4,918,468	10.5	C 1
STANFORD	GAS	OIL	ELEC	$ 958,000	1.60%	$ 2,076,000	2.60%	217%	18.00%	12,500	3,650,000	11	C 1
TULANE	GAS		ELEC	$ 1,000,000	2.10%	$ 1,140,000	2.00%	114%	10.00%	7,000	1,000,000	12	CD*
U OF CALIF													
BERKELEY	GAS	OIL	ELEC	$ 1,297,131	.80%	$ 3,194,867	1.50%	246%	16.00%	29,730	11,700,698	10.5	C 2
DAVIS	GAS	OIL	ELEC	$ 812,369	1.00%	$ 1,553,885	1.00%	191%	10.00%	16,239	6,022,500	11	C 2
IRVINE	GAS	OIL	ELEC	$ 328,061	1.20%	$ 1,142,150	2.20%	348%	26.00%	8,764	2,350,922	9	C 2
LOS ANGELES	GAS	OIL	ELEC	$ 1,872,476	1.00%	$ 4,803,669	1.60%	257%	25.00%	31,966	12,701,785	12	C 2
SAN DIEGO	GAS	OIL	ELEC	$ 67,400	1.40%	$ 119,800	1.60%	178%	22.50%	1,482	738,762	11	C 2
SAN FRAN.	GAS	OIL	ELEC	$ 545,886	.70%	$ 1,126,250	.80%	206%	10.00%	2,992	3,019,242	12	D 2
SANTA BARB.	GAS	PROP	ELEC	$ 663,048	1.60%	$ 1,400,000	2.40%	211%	22.00%	13,277	3,524,100	9	C 2
UTAH	GAS	COAL	ELEC	$ 1,216,175	1.60%	$ 1,692,135	1.50%	139%	12.00%	21,751	5,692,210	10	C 2
WASHINGTON	GAS	C+OIL	ELEC	$ 1,159,804	1.10%	$ 2,462,991	1.30%	212%	18.00%	34,500	9,713,665	11	C 2
WISCONSIN	GAS	COAL	ELEC	$ 2,686,798	1.61%	$ 6,006,543	2.14%	233%	12.00%	34,062	13,873,934	12	CD2
YALE	OIL		ELEC	$ 1,987,634	1.60%	$ 7,520,300	4.50%	378%	36.00%	9,000	10,000,000	12	CD1
AVERAGE					1.24%		2.14%	246%	17.53%				

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UNIVERSITIES AND 4 YEAR COLLEGES
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AMARILLO	GAS		ELEC	$ 91,147	2.80%	$ 150,560	2.60%	165%		2,964	685,952	12	B 2
ANGELINA	GAS		ELEC	$ 34,961	3.80%	$ 42,942	2.90%	123%	14.50%	801	161,728	12	B 2
DALLAS C.C.	GAS		ELEC	$ 95,305	1.10%	$ 734,160	2.80%	770%		16,055	1,244,381	12	B 2
GRAYSON JR.	GAS		ELEC	$ 36,442	1.90%	$ 115,815	4.00%	318%		2,317	523,371	12	B 2
JEFFERSON ST.JR	GAS		ELEC	$ 41,351	1.50%	$ 232,862	4.20%	563%		5,677	395,006	12	B 2
LAREDO JR.	GAS		ELEC	$ 45,109	4.10%	$ 123,774	3.40%	274%		1,946	438,682	12	B 2
ODESSA JR.	GAS		ELEC	$ 49,002	1.37%	$ 58,149	1.50%	119%		3,176		10.5	B 2
ST LOUIS JR.	GAS		ELEC	$ 544,771	4.10%	$ 704,021	2.70%	129%	16.10%	17,190	1,700,000	12	B 2
SAN ANTONIO JR.	GAS		ELEC	$ 141,225	1.40%	$ 400,000	2.20%	283%	13.70%		854,582	12	B 2
TARRANT CTY JR.	GAS		ELEC	$ 153,456	2.90%	$ 270,000	2.00%	176%	4.40%	9,882	932,132	12	B 2
AVERAGE					2.42%		2.64%	229%	12.17%				

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